CHAPTER ONE

Population

Population size, distribution, mobility, age structure, and rate of growth all affect the environment. They affect what resources are used, where, when, how, and at what rate, and with what attendant waste or conservation. An increase in population will heighten demand for food, energy, water, health care, sanitation, and housing. Those demands can be met in a variety of ways, with potentially significant differences in environmental impact.

The relationships between population, environment, and resources have been the subject of a long debate. One of the earliest contributors was the 18th Century English economist Thomas Malthus. Noting that population was growing faster than agricultural production, Malthus theorized that population growth would ultimately be constrained by the amount of land available for food production. He described a feedback process in which overpopulation would produce widespread famine, illness, and death, which in turn would reduce population size. Malthus' *Essay on the Principle of Population* is available online (http://www.trmalthus.com/essay.htm).

Since Malthus' time, many other researchers have examined population-environment-development linkages. Some have stressed the role of rising affluence and per capita consumption as greatly exacerbating sheer population size; others have stressed the role of population density in combination with economic conditions; and still others have stressed the role of technological innovation and substitution of materials in ameliorating the impacts of population growth.

For example, some environmental trends may be associated with changes in per capita income. The economist Simon Kuznets studied the relationship between income inequality and per capita income. He found an inverted-U relationship: income inequality increased for low-income countries as per capita income increased, but at some point, the inequality leveled off and then began to fall as per capita income rose to the level of a more developed country. Kuznets' work has since been applied to trends in pollution as a function of per capita income. In this case, patterns of emissions of air and water pollutants across countries seem to increase when income per capita is low, and fall when income per capita rises. Thus, countries that experience a certain level of development should experience

declining pollution with economic growth, because of increased demand for environmental protection with higher income.

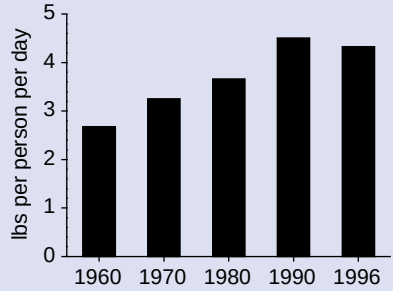
This theory has drawn some criticism and certainly does not apply to all environmental problems. For example, greenhouse gas emissions, which have no local effects, seem to increase with income at all income levels. Furthermore, a number of studies have found that turning points in the relationship between economic growth and environmental quality usually result from explicit policy actions. This suggests that countries cannot expect that growth alone will automatically result in improvements in environmental quality.

Government policies and technological advances can significantly alter the population-environment linkage. For example, industrial efficiency improvements can offset rising consumption caused by population growth. In the case of wood, many sawmills today produce twice as much usable lumber and other products per log input as they did a century ago. Another example is pollution controls on cars and trucks, which—by lowering emissions per vehicle—have helped to offset pollution caused by the rising number of cars and trucks on the nation's roads.

Apart from the issue of linkages, population data and demographics can be a useful tool for understanding trends in some environmental problems. For example:

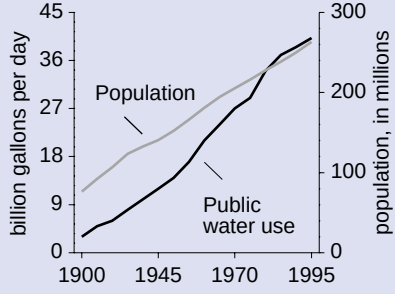
- In the case of radon, knowing population size and rate of change will help in estimating national or regional exposure rates. Migration trends can indicate the potential for increasing radon exposure in certain geographic regions.
- Even if per capita generation of solid waste is constant, population growth generally leads to greater waste generation. Per capita waste generation in the U.S. increased from 1960 to 1990, but has declined slightly since then (Figure 1.1).
- Increasing population size implies increasing demand for drinking

Figure 1.1 U.S. Per Capita Solid Waste Generation, 1960-1996



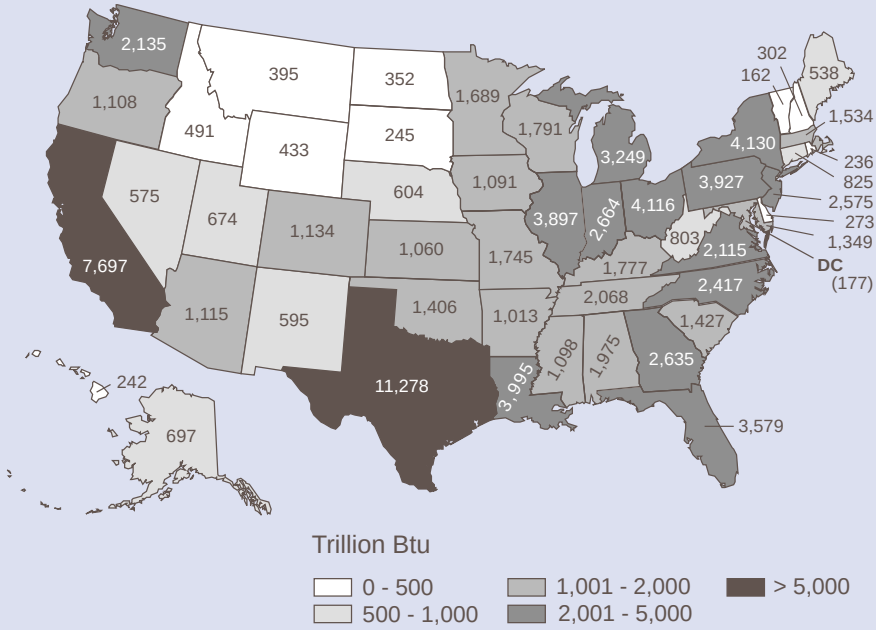
Source: See Part III, Table 8.1.

Figure 1.2 U.S. Public Water Use, 1900-1995



Sources: See Part III, Table 1.1 and Table 6.3.
Notes: Public water use refers to public supply provided for households, municipalities, commercial establishments, etc. Does not include self-supplied water (e.g., wells).

Figure 1.3 Energy Consumption Estimates by State, 1996



Source: U.S. Department of Energy, Energy Information Administration, *State Energy Data Report 1996* (DOE, EIA, Washington, DC, 1999).

water (Figure 1.2). Population distribution also affects local and regional demand for water and the distribution of sources of pollution. Similar patterns are seen in energy consumption (Figure 1.3).

- In coastal and estuarine areas, population growth implies greater potential for pollution of water resources and habitat/land use alteration. Population growth in upstream areas or near sensitive areas can adversely affect estuarine and coastal water quality.

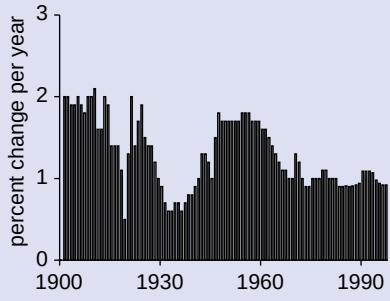
These connections are described in *The Population-Environment Connection*, a report of the Battelle Seattle Research Center prepared for the Environmental Protection Agency. The report is available online (http://www.seattle.battelle.org/services/e&s/pop-env/index.htm).

TRENDS

U.S. Population

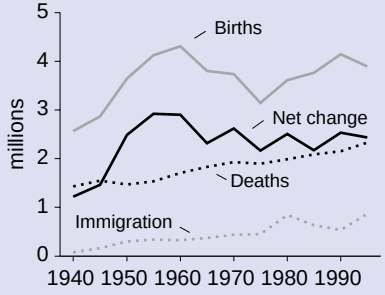
Unlike most other developed nations, the U.S. population is continuing to increase, though at the relatively slow pace of about one percent per year. This is about half the rate of the baby boom years following World War II; in 1950, for example, U.S. population increased 2.05 percent. Annual percentage increases continued at more than 1.5 percent through

Figure 1.4 U.S. Population Growth Rate, 1900-1997



Source: See Part III, Table 1.1.

Figure 1.5 Components of U.S. Population Change, 1940-1997



Source: See Part III, Table 1.2.

1962, and then dropped quickly to the 1 percent level by 1968 (Figure 1.4).

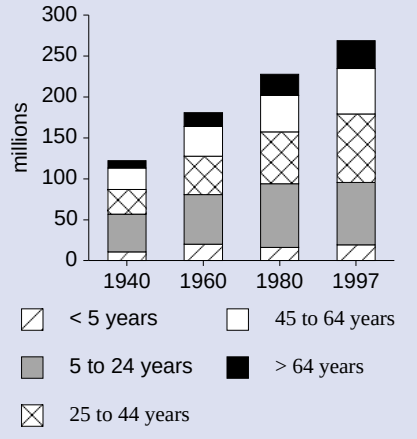
In absolute numbers, the Commerce Department's Bureau of the Census estimates the U.S. population in 1997 at 267.64 million, an increase of about 18 million people since 1990. (Part III, Table 1.1.)

Births continue to be by far the largest factor in U.S. population increase. In 1997, there were 3.9 million births and 2.3 million deaths. Net immigration was estimated at 868,000, resulting in a net increase in population of 2.44 million (Figure 1.5). (See also Part III, Table 1.2.)

Over the period from 1940 to 1997, the proportion of the population in older age groups has increased considerably (Figure 1.6). In 1940, there were an estimated 9 million people over the age of 64; in 1997, there were 34 million people in that category. Growing elderly populations in popular retirement areas like Florida have significant environmental implications. (Part III, Table 1.3)

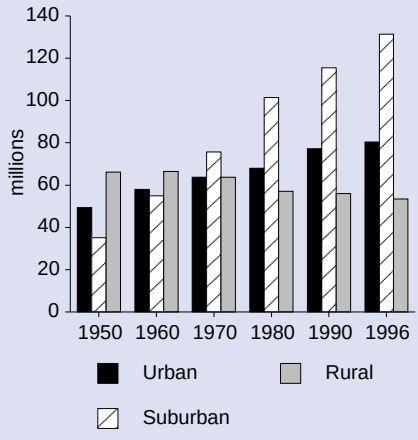
Over the course of this century, the nation's population has changed from primarily rural to primarily urban and suburban (Figure 1.7). Since 1950, suburban areas have grown dramatically, increasing from 35 million people (23 percent of the total population) to 131 million (50 percent of the total in 1996). Rural population has shrunk from 66 million people in 1950 (44 percent of the total) to 54 mil-

Figure 1.6 U.S. Population Distribution by Age, 1940-1997



Source: See Part III, Table 1.3.

Figure 1.7 U.S. Urban, Suburban, and Rural Population, 1950-1996



Source: See Part III, Table 1.4.

lion people in 1996 (20 percent of the total). (Part III, Table 1.4.)

Population has increased in all regions of the country, but the rate of increase has been fastest in the West—growing from 4 million to 59 million from 1900 to 1997—and the South—growing from 25 million to 94 million over the same period (Figure 1.8). (Part III, Table 1.5) In terms of regional migration, the pattern since 1960 has been characterized by movement from the Northeast and Midwest to the South and West.

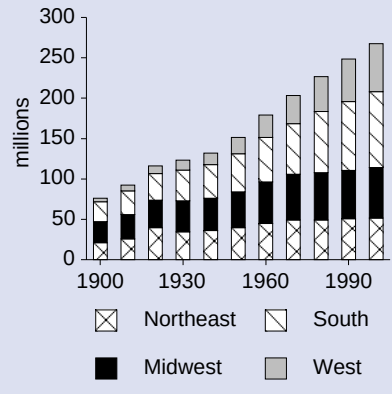
For the U.S. as a whole, average population density in 1997 was 77 people per square mile. Densities in coastal regions (except in the Pacific) are much higher, however. (Part III, Table 1.6) For example, average population density was estimated at 418 per square mile in 1997 along the Atlantic coast and 231 per square mile in the coastal counties of the Great Lakes (Figure 1.9).

Over the period from 1969 to 1997, the number of people living below the poverty line has fluctuated from a low of 23 million in 1973 (11 percent of the population) to a high of 39 million in 1993 (15 percent of the population). In 1997, the total was estimated at 35.6 million, or 13.3 percent of the population. The number of people in poverty declined for all races, pointing to the widespread benefits of a growing economy across the population. In terms of residence, about 15 million poor people were living in urban areas, 12 million in suburbs, and 8 million in rural areas (Figure 1.10). (Part III, Table 1.7)

Global Trends

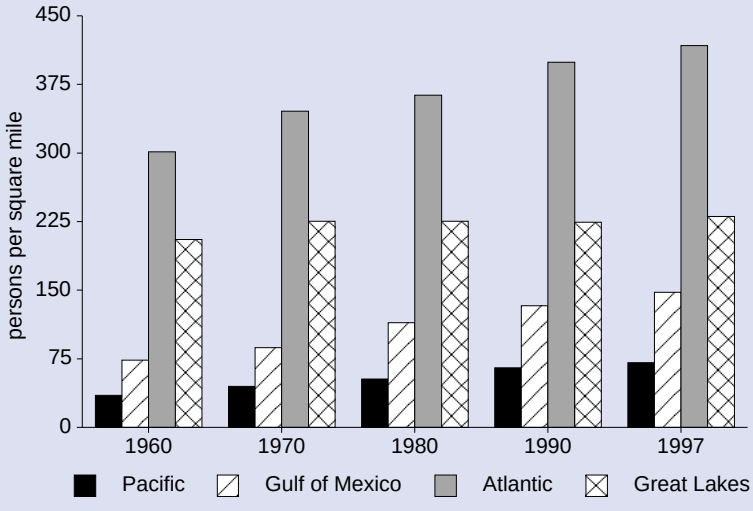
The United Nations Population Information Network (POPIN) (http://www.undp.org/popin) is a comprehensive source of information on global population trends.

Figure 1.8 U.S. Population by Region, 1900-1997



Source: See Part III, Table 1.5.

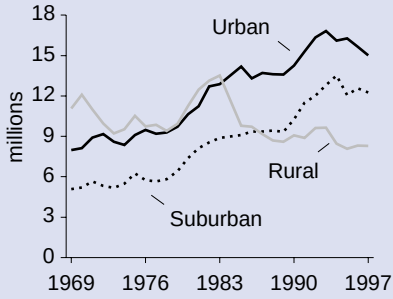
Figure 1.9 U.S. Coastal Population Density, 1960-1997



Source: See Part III, Table 1.6.

The site includes information on world population projections to the year 2150, trends in fertility rates, additional deaths due to AIDS, child mortality, urbanization, migration flows, and urban agglomerations. *World Population Prospects: The 1998 Revision*, which is prepared by the Population Division of the Department of Economic and Social Affairs at the United Nations Secretariat, provides estimates and projections for the global population for the period 1950-2050.

Figure 1.10 U.S. Population Below Poverty Level by Place of Residence, 1969-1997



Source: See Part III, Table 1.7.

A recent UN study, *World Population Projections to 2150*, provides several different scenarios for future global population, with the differences attributable to different assumptions about future scenarios in total fertility rates (Figure 1.11).

Slight differences in assumptions about fertility yield large differences in the ultimate global population. According to the medium fertility scenario, world population will grow from 5.7 billion in 1995 to 9.4 billion by 2050, 10.4 billion by 2100, and 10.8 billion by 2150. Under the high-fertility scenario, which assumes that total fertility rates will converge at around 2.5 children per woman by 2050, population will grow to 11.2 billion by 2050, 17.5

billion by 2100, and 27 billion by 2150. Under a low-fertility scenario, which assumes that total fertility rates will eventually stabilize at levels between 1.35 and 1.6 children per woman, population would increase to 7.7 billion by 2050, but then decline to 5.6 billion in 2100 and to 3.6 billion by 2150.

The different rates of population growth will lead to a substantial redistribution of global population. Under the medium-fertility scenario, the share living in the currently developed world will decrease from 18 to 9 percent during the 1995-2150 period.

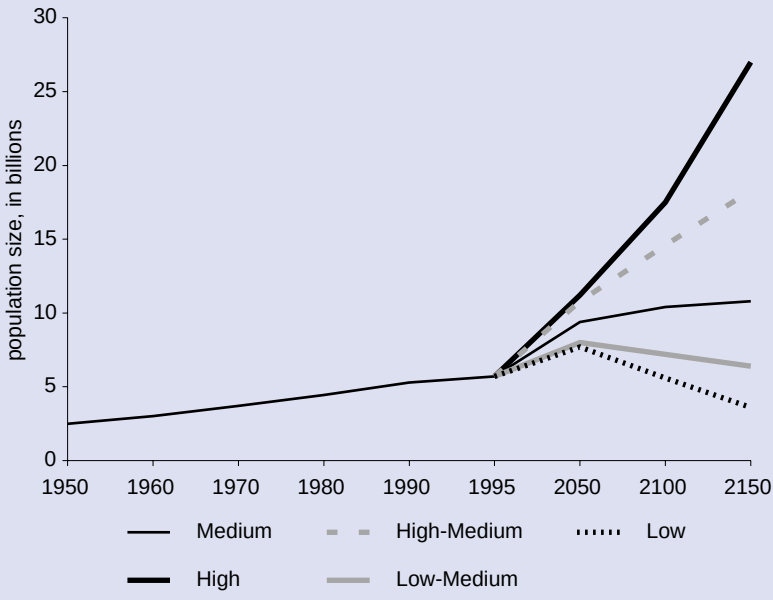
Declining fertility and mortality rates will lead to a dramatic population ageing. In the medium-fertility scenario, the share aged 60 years or more will increase from 9 to 30 percent of the world population between 1995 and 2150.

ONLINE RESOURCES

The website maintained by the U.S. Census Bureau (http://www.census.gov) provides a vast quantity of information on U.S. population, housing, and economic indicators.

For example, the tables printed in the *Statistical Abstract of the United States* are available online (http://www.census.gov/prod/3/98pubs/98statab/cc98

Figure 1.11 World Population Size According to Main Fertility Scenarios, 1950-2150



Source: United Nations, Department of Economic and Social Affairs, Population Division, *World Population Projections to 2150* (UN, New York, 1998).

stab.htm). The U.S. population census also is available (http://www.census.gov/population/www/), including information on population counts by race and Hispanic origin, age groups by sex, and household characteristics.

The Census Bureau also has published numerous studies on migration and geographic mobility, including three recent reports in *The Current Population Survey*. A guide to these sources is available (http://www.census.gov/population/www/socdemo/migrate.html).

For studies relating to population and the environment, the web site maintained by the Population Reference Bureau (http://www.prb.org) is particularly valuable. PRB manages PopNet (http://www.popnet.org), which presents information on topics such as demographic statistics, economics, education, environment, gender, and reproductive health. It includes links to government and international organizations, nongovernment organizations, university centers, and associations.

PopNet's population and environment category provides a long list of links to other sites, including the Center for International Earth Science Information (CIESIN), the Food and Agriculture Organization of the United Nations (FAO), the International Institute for Applied Systems Analysis (IIASA), the International Institute for Sustainable Development, the National Academy of Sciences, the National Audubon Society's Population and Habitat Campaign, the United Nations Development Programme (UNDP), the World Bank, the World Resources Institute (WRI), and the Worldwatch Institute.

These sites provide a massive amount of information related to population, resources, and environment. For example, the CIESIN site provides access to thousands of resources related to population and the environment. The "Gridded Population of the World" includes world and continental population counts and population density.

PopNet's section on demographic statistics provides links to global, national, and institutional demographic databases. It includes links to most national demographic statistics, along with other links to the CIA World Factbook, Demographic and Health Surveys (an important source of information on fertility, knowledge and use of family planning, and maternal and child health in developing countries), EUROSTAT (the home page of the Statistical Office of the European Communities), a mortality database produced by the World Health Organization, and the weekly mortality and morbidity report produced by the U.S. Centers for Disease Control and Prevention.

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CORE DATA

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